

What is Claimed is:

- 1 1. A bonding structure with compliant bumps, comprising:
 - 2 a device, further comprising:
 - 3 a first substrate acting as a carrier,
 - 4 at least a metal bonding pad on said first substrate, said metal bonding pad
 - 5 providing electrical conduction to said first substrate,
 - 6 a first protection layer on the surface of said first substrate, said first protection
 - 7 layer covering outside of said metal bonding pads and providing insulation and
 - 8 protection,
 - 9 at least a compliant bump providing a solder point and a conductive channel for
 - 10 said device, and
 - 11 at least a stopper structure for controlling the deformation extent of said compliant
 - 12 bump to prevent said compliant bump from cracking during bonding,
 - 13 a second substrate having at least a conductive electrode; and
 - 14 a film between said device and said second substrate for bonding said device to said
 - 15 second substrate.
- 1 2. The bonding structure as claimed in claim 1, wherein said compliant bump further
2 comprises:
 - 3 a metal layer on top of said metal bonding pad and said first protection layer for
 - 4 bonding polymer material and said metal bonding pad;
 - 5 at least a polymer bump on said metal layer for providing the main body of said

6 compliant bump; and

7 a conductive layer covering said polymer bump and forming a conductive channel
8 with said metal bonding pad and said metal layer.

1 3. The bonding structure as claimed in claim 2, wherein said compliant bump covers
2 said conductive layer of said polymer bump and the covered area ranges from 0.1% to
3 99% of the area of said polymer bumps.

1 4. The bonding structure as claimed in claim 1, wherein said compliant bump has one of
2 the shapes of rectangle, square, trapezoid, sphere, round column, cone, an irregular
3 shape, and any combination of the above shapes.

1 5. The bonding structure as claimed in claim 1, wherein said compliant bump has a
2 convex-concave surface to reduce the contact surface with said second substrate to
3 lower the required bonding pressure.

1 6. The bonding structure as claimed in claim 5, wherein the convex of said convex-
2 concave surface has one of the shapes of rectangle, square, trapezoid, sphere, round
3 column, cone, an irregular shape, and any combination of the above shapes.

1 7. The bonding structure as claimed in claim 1, wherein said compliant bump is elastic.

1 8. The bonding structure as claimed in claim 1, wherein said compliant bump is
2 deformable.

1 9. The bonding structure as claimed in claim 1, wherein said stopper further comprises:
2 a metal layer on top of said metal bonding pad and said first protection layer for
3 providing bonding to polymer material; and

4 at least a polymer bump on said metal layer for providing the main body of said
5 compliant bump.

1 10. The bonding structure as claimed in claim 9, wherein said stoppers are distributed
2 over said device ranging from 0.1% to 99% of the area of said device.

1 11. The bonding structure as claimed in claim 1, said stopper has one of the shapes of
2 rectangle, square, trapezoid, sphere, round column, cone, an irregular shape, and any
3 combination of the above shapes.

1 12. The bonding structure as claimed in claim 1, wherein said stopper is distributed
2 outside of said compliant bump, and has one of the distribution shapes of spot, bar,
3 continuous bar, delimited bar, arc, fan, and any other shapes.

1 13. The bonding structure as claimed in claim 1, wherein said stopper is distributed inside
2 of said compliant bump, and said compliant bump has a convex-concave surface to
3 reduce the contact area with said electrode of said second substrate to lower required
4 pressure in bonding.

1 14. The bonding structure as claimed in claim 13, wherein the convex of said convex-
2 concave surface has one of the shapes of rectangle, square, trapezoid, sphere, round
3 column, cone, an irregular shape, and any combination of the above shapes.

1 15. The bonding structure as claimed in claim 1, wherein said stopper is elastic.

1 16. The bonding structure as claimed in claim 1, wherein said stopper is deformable.

1 17. The bonding structure as claimed in claim 1, wherein said device further comprises a
2 second protection layer formed by said metal layer and a polymer layer to provide
3 grounding and protecting said first substrate.

- 1 18. The bonding structure as claimed in claim 17, wherein said polymer layer is on top of
2 said metal layer and made of the same material of said polymer bump.
- 1 19. The bonding structure as claimed in claim 17, wherein said second layer covers the
2 area of said device ranging from 0.1% to 99%.
- 1 20. The bonding structure as claimed in claim 17, wherein said second protection layer is
2 lower than said compliant bump and said stopper.
- 1 21. The bonding structure as claimed in claim 17, wherein said second protection layer is
2 connected to said stopper.
- 1 22. The bonding structure as claimed in claim 17, wherein said second protection layer is
2 separate from said stopper.
- 1 23. The bonding structure as claimed in claim 1, wherein said film is a conductive film.
- 1 24. The bonding structure as claimed in claim 1, wherein said film is a non-conductive
2 film.
- 1 25. The bonding structure as claimed in claim 1, wherein said film is a non-conductive
2 glue.
- 1 26. The bonding structure as claimed in claim 1, wherein said device and said second
2 substrate are bonded using one of the methods of thermal consolidation, thermal
3 compressing consolidation, UV consolidation, ultrasonic consolidation, and any
4 combination of the above methods.
- 1 27. The bonding structure as claimed in claim 1, wherein said first substrate is an
2 integrated circuit, a silicon chip or a silicon wafer.

1 28. The bonding structure as claimed in claim 1, wherein said second substrate is a glass
2 substrate, a polymer substrate, an organic substrate, a non-organic substrate, or a
3 silicon substrate.

1 29. The bonding structure as claimed in claim 1, wherein said stopper structure is higher
2 than said second protection layer and has a different height from said compliant bump.